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SWEET POTATOES.

BY

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LETTER OF TRANSMITTAL.

U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF PLANT INDUSTRY,
Washington, D. C., February 18, 1901.

SIR: I respectfully transmit herewith a paper on Sweet Potatoes, by Mr. D. M. Nesbit, a practical sweet-potato grower of Maryland. This paper was prepared upon the request of Maj. Henry E. Alvord, Chief of the Dairy Division, Bureau of Animal Industry, through whose efforts the sweet potato was included among the work of said Bureau in promoting the development and extension of foreign markets with which it is charged. Through Major Alvord, Mr. Nesbit laid before the Department certain data relative to the availability of sweet potatoes and their products as articles of export and was appointed special agent to take charge of the experimental shipments which were subsequently made by the Department under the direction of Dr. D. E. Salmon, Chief of the Bureau named. After the close of the export season he was engaged to prepare this paper, which embodies the information he thus acquired regarding sweet-potato farming in the United States.

In view of the growing interest in sweet-potato culture and the importance of the crop as an export product, I respectfully recommend that the paper be published as a Farmers' Bulletin.

Respectfully,

B. T. GALLOWAY,
Director of Plant Industry.

Hon. JAMES WILSON,
Secretary of Agriculture.

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SWEET POTATOES.

INTRODUCTION.

This bulletin does not discuss the origin and history of the sweet potato nor treat of it with especial reference to its position in the plant world, its fungus parasites, or its insect enemies. It is rather an economic view of a subject which is of very great practical interest to planters, stock breeders, and dairymen in the southern half of the United States, and to consumers throughout the country, a subject which is developing on all sides into new importance, and which promises in the near future to engage the serious attention of exporters.

IMPROVEMENT IN VARIETIES.

This increase of interest in the sweet potato as an article of food is both a cause and result of improvements in varieties, methods of propagating, planting, fertilizing, cultivating, harvesting, storing, shipping, and cooking. A few years ago sweet potatoes were rarely seen in the northern parts of the United States after November. Now, by the use of suitable cars, they are shipped long distances in winter with safety, and through the introduction of canning their use is still further extended. Dried sweet potatoes and sweet-potato flour, starch, glucose, and alcohol are not new products, but they have never been of commercial importance. Now inventors are active in perfecting machinery and processes by which they expect to be able to make these products of such excellence and so cheaply as to insure a large demand for them in home and foreign markets. And lastly, the value of the sweet-potato, vines and roots, for stock feeding is only beginning to be understood. These and other features of the subject will be considered separately in the following pages.

NOMENCLATURE.

Confusion prevails in sweet-potato nomenclature from the beginning, even before we come to consider varieties. Botanists have named the plant *Ipomea batatas*. To them the underground parts are "roots."

Tuberous roots.—Those portions of the roots which are enlarged more or less beyond the requirements of anchoring and feeding the

plant may be referred to as "tuberous roots," but not as "tubers." To the botanist there is no such thing as a sweet-potato tuber. On the other hand, in the language of the farm, the word root applies first to the thread-like fibers through which the plant feeds, and later, on the farm and in the market, to those enlarged portions of the underground structure of the plant which are too small to be classed as "primes" or good "seconds." Primes and seconds are not roots in popular language, and to call them so, without explanation, among planters or dealers would lead to misunderstanding. Manifestly then we have in botanical language no distinguishing popular name for the edible, marketable roots of the sweet potato. In the market those "tuberous roots" of the sweet potato which attain the size of primes or seconds are often called "sweets"—a convenient name for commercial use, but one that has not been adopted in literature other than market reports. In those sections of the South where the "Irish," "White," or "Round" potato, *Solanum Tuberosum*, is little cultivated and enters still less into home consumption, the word potato serves to indicate fairly well the edible, marketable root of the sweet potato, but nowhere else is this so. And it is of no present importance that the sweet potato had the first claim on that name, since it has been given by common consent to a rival of another family.

Tubers.—These alternatives remain for a popular treatise in referring to the edible roots of the sweet potato—to substitute a descriptive phrase for a name, to repeat the name sweet potato with tiresome iteration and the indefiniteness of calling the edible roots by the name of the plant, or to refer to the edible roots as tubers. The latter is the more common custom, and the writer wishing to be understood without employing unnecessary words, will frequently refer in the following pages to the edible roots of the sweet potato as tubers.

The want of a simple, clean cut, unmistakable name for the sweet potato, a name not shared with any other vegetable, has been singularly emphasized in the exclusion of a consignment of American sweet potatoes from France under an edict which was aimed at the Irish potato. This incident is referred to more particularly later on (p. 31).

Yams.—Some varieties of the sweet potato are called yams, but it would be impossible to group these varieties into a distinct, well-defined class, and so this name, borrowed from a different family of plants, adds to the confusion in which the nomenclature of varieties of the sweet potato is involved.

VARIETIES OF SWEET POTATOES.

A list is here given of eighty names which appear in recent publications, and are more or less generally used to designate varieties of the sweet potato. Those varieties called yams are included, but no

account is taken of the *Dioscorea Batatas*, or Chinese yam, which is not a sweet potato.

Popular Names.

(1) Barbadoes.
(2) Bermuda Red.
(3) Bermuda White.
(4) Big Stem Jersey.[1]
(5) Black Spanish.
(6) Boca Sagarto.
(7) Boone's Red.
(8) Boone's White.
(9) Brazilian (yam).[2]
(10) Bronze.
(11) Bunch (yam).
(12) Canal.
(13) Cavitt's Earliest.
(14) Chinese Thirty Days.
(15) Cuban (yam).
(16) Delaware.
(17) Dog River.
(18) Early Caroline.
(19) Early Golden.
(20) Early Jersey.
(21) Extra Early Caroline.
(22) Early Rivers.
(23) Florida (yam).
(24) General Grant.[3]
(25) Georgia (yam).
(26) Gold Skin.
(27) Hall.[4]
(28) Hanover.[5]
(29) Hayman.
(30) Hayti Spanish.
(31) Heckler (yam).
(32) Hunt's Red.
(33) Java, No. 1.
(34) Java, No. 2.
(35) Java, No. 3.
(36) Java, No. 4.
(37) Java, No. 5.
(38) Jersey Red.
(39) Jersey Sweet.[6]
(40) Jerusalem (yam).
(41) Lexington (yam).
(42) Louisiana (yam).
(43) Matejita.
(44) Mexican.[7]
(45) Nansemond.[8]
(46) Nansemond Red.
(47) Nansemond White.
(48) Negro Choker.
(49) New Jersey.
(50) Nina.
(51) Norton.
(52) Old Maurice.
(53) Orange.
(54) Orleans Red.[9]
(55) Paragon.
(56) Padisha.
(57) Peabody.
(58) Peruvian (yam).
(59) Pimento.[10]
(60) Poland.
(61) Pool's (yam).
(62) Porto Viejo.
(63) Providence.
(64) Pumpkin (yam).
(65) Redding.
(66) Red Nose.
(67) Rockport.
(68) San Domingo.[11]
(69) Shanghai.[12]
(70) Southern Queen.[13]
(71) Southern Red (yam).
(72) Spanish (yam).
(73) Strasburg.
(74) Sugar (yam).[14]
(75) Tennessee.[15]
(76) Ticotea.
(77) Up River.
(78) Vineland Bush.
(79) Vineless.
(80) Yellow.[16]

This list is not complete, but is used to bring together names that are found in Experiment Station Reports, catalogues, and other publications. If names used only locally were included, the list would be much longer.

It should not be taken for granted that each name in the list indicates a distinct variety. The influences of selection, climate, soil, fertilization, and culture are such that a variety cultivated under different conditions might soon develop marked variations. If the eighty supposed varieties here named were planted a few years under uniform conditions and with a method of selection tending toward uniformity

[1] Big Stem. Improved Big Stem.
[2] White Brazilian.
[3] Caddle. Florida Yam.
[4] Nancy Hall.
[5] Royal of Hanover. Nansemond Improved.
[6] Yellow Jersey.
[7] Bahama Yam.
[8] Yellow Nansemond.
[9] Choker.
[10] Yellow Pimento.
[11] White St. Domingo.
[12] California.
[13] Queen of the South.
[14] Creole.
[15] Tennessee Yam.
[16] Yellow Yam.

rather than diversity, it might be that half of the names could be dropped as duplicates, and that half of the forty varieties remaining should be discarded as having no merits to warrant their continued propagation. This opinion is confirmed by the fact that those sections which produce sweet potatoes mainly for home consumption are the most prolific of varieties and names, while those other sections which contribute regularly to large markets have few names and still fewer varieties. Of the names in the list not more than ten are commonly used by growers who depend on Northern markets, and it is doubtful if the ten names used indicate more than five varieties.

Types.—General markets call for a few types and give little attention to names of varieties. "Carolina Reds," "Virginia Sweets," "Jersey Sweets," "Vineland Sweets," "Nearbys," "Merceds," "Muscatines," and the like are names of types rather than names of varieties. Nor is it safe to assume that all of the sweet potatoes seen in the markets grew where the market name indicates. For instance, New Jersey growers have created a reputation for their sweet potatoes, and now more "Jersey Sweets" are sold than that State produces.

Foliage system of classification.—Classifications of varieties based on different principles have been attempted without, as yet, rescuing the subject from disorder. The most elaborate system, and perhaps the only one worthy of a name, is that adopted by R. A. Price, horticulturist of the Texas Experiment Station in 1893, which he calls the "Foliage system." He divides sweet potatoes into three groups, having "round or entire foliage," "shoulder foliage," and "split or lobed foliage." He says, "If this foliage system is taken in connection with a short description of the color of the tubers and of the vines, there is scarcely a variety which can not be distinguished from all other varieties."

This system has been applied at several stations, yet it would be quite impossible to recognize some varieties as known in one section by descriptions given of them according to the foliage system in another section if the name were omitted. So strong are the influences tending toward diversity that the writer is convinced that no system of classification can demonstrate much value until the supposed varieties are all brought together and propagated under uniform conditions for several years.

Elimination of inferior varieties.—Whether much or little of economic value shall be accomplished through the foliage system or other systems of classification, there can be no doubt that the organization of planters in granges, clubs, associations, exchanges, etc., for business purposes is tending toward the elimination of inferior varieties and the production of uniformity and excellence in the varieties, by whatever name they may be known, that are wanted in the markets.

No description of varieties will be attempted here. Any person not

familiar with sweet potatoes, who wishes to plant, would do well to consult the most successful growers of his vicinity and to buy from them plants or tubers for propagating. It is not wise for a beginner to invest much in new varieties at high prices with the expectation of selling his crop for seed to men who are in the business. The result of such enterprise is likely to be disappointing.

The vining habit of the sweet potato is natural, and is not troublesome to growers of experience. Certain "vineless" or "bush" varieties, so called, have been developed, but they have not as yet been generally adopted. It is claimed for them that the quality of the tubers is excellent, and that they are good keepers. In yield they are likely to fall below the best old varieties. It has not been demonstrated that vines are a useless appendage of the sweet-potato plant.

Requirements of the markets.—The essentials of any variety for profitable field culture are vigor, earliness (where earliness is an object), productiveness and color, form and size, according to the requirements of the markets in which they are to be sold. If they are intended for winter or spring use, good keeping quality is also essential. The markets of the North prefer a dry yellow sweet potato of medium size and comely shape. These qualities are found in the Jersey type. Sweet potatoes of this class are planted, under several names, almost to the exclusion of other kinds, in New Jersey, Delaware, Maryland, the Eastern Shore of Virginia, and the middle West. Farther south, in sections shut off from Northern markets by excessive freight rates, the moist varieties that exude a sugary sirup in baking are in demand in local markets. For stock feeding the larger and coarser varieties are chosen for their greater productiveness.

CLIMATE.

The sweet potato thrives only in a warm climate. Where there is no frost it is perennial. A temperature below 45° F. injures it, and frost is immediately fatal. On soils suited to the sweet potato it may be grown wherever the large dent varieties of maize reach maturity, but when grown near its northern limit or at high altitudes it generally lacks sweetness and flavor. This loss of quality must be attributed to the cool nights which are likely to prevail in high latitudes and at considerable elevations in lower latitudes during the latter part of the growing season, a condition which does not admit of the growing of sweet potatoes in a large way. It is quite possible, however, for farmers to have their own supply of excellent sweet potatoes, and enough for sale at good prices to pay all expenses, by starting plants in pots and transferring them to the open ground when danger of frost is past.[1] An effective and inexpensive substitute for pots may be made

[1] If threatened with frost after the plants are set out, they may easily be covered. For this purpose nothing is more convenient than the common strawberry basket.

of strips of strawboard 4 by 12 inches rolled into the form of a cylinder and held in place by a string. These cylinders are set on a board, and require no other bottom. In transplanting it is not necessary to remove the cylinders. By starting the plants early the tubers are formed under as favorable conditions as prevail later in lower latitudes or at less elevation.

For profitable general field culture the sweet potato requires at least four months of warm weather, free, not only from frost, but from cold winds and from the cool nights that prevail in summer at the North and at high altitudes everywhere.

Sweet potatoes do not suffer as quickly as Irish potatoes from drought, but are injured by excessive rainfall and over irrigation.

SOILS AND FERTILIZATION.

In a suitable climate and with good cultivation the sweet potato will thrive on any well-drained soil. Nevertheless, it should not be planted on heavy or peaty soils unless intended for stock feeding. It is not always practicable to harvest the crop when the ground is dry, and such soils, unless they are very dry, adhere to the tubers and so detract from their value. Moreover, the quality of sweet potatoes grown on these soils is always relatively low. The best soil for the sweet potato is a light, well-drained, but not leachy sandy loam that will not adhere to the potatoes. If the best quality is desired, soils which have an excess of organic matter should be avoided. Excellent sweet potato lands abound on the Atlantic slope from New Jersey to Florida, and are not unknown in the Mississippi Valley and in the arid regions, where irrigation is required. In the Atlantic coast region there are also large tracts of barren sand having no retentive subsoil. Even such land, with judicious fertilizing and in seasons of well-distributed rainfall, produce fair crops of sweet potatoes which are of excellent quality.

Where suitable sandy soils are not available, a good substitute is sometimes found in those of slaty origin.

The question of fertilizers is so closely related to that of soils that the two can not be separated. The first and plainest function of the soil in its relation to the plant is to give the plant a place. A soil which should do no more than this would be a plant hotel on the European plan, furnishing room without board. Every soil, however poor, does more than this. Every soil contributes of its own substance to the nourishment of the plant. It will be understood that we refer to natural soils, not to sand which has been sterilized artificially for experiments in pot culture.

Degrees of fertility.—Soils are of all degrees of fertility, from those so nearly barren that they support without aid only a stunted growth of vegetation to the richest soils, which contain stores of plant food

far beyond the needs of the plants growing upon them. And this diversity in soils extends not alone to one element but to all elements of fertility. A soil may be rich in one element and poor in others.

It is apparent, then, that no experiment with fertilizers which does not take into account the plant food already available in the soil must be taken without question to indicate the deficiencies of other soils. A soil is like a bank account. A merchant having a large amount of money in bank may issue checks without stopping to balance his account. And so there are soils rich enough to pay all drafts made upon them, but, as has been stated, such soils do not produce the best sweet potatoes. The sweet-potato planter who does not consider the strength of his soil is likely either to waste money in supplying what it does not need or to have his drafts protested.

The planter must know his soil.—With the planter nothing can take the place of a knowledge of his soil. A report on a soil by an analytical chemist is the diagnosis of a soil disease by a specialist. The soil may have infirmities out of the specialist's line. Anyway, analysis is somewhat costly, and its value depends on the analyst, the soil, and the planter. Whatever its merits in this connection may be, they are likely to be made apparent in the work of the experiment stations, public or private, rather than in the operations of men who plant for profit. One who can not judge of the capability of his soil without a chemical analysis of it is like a man who depends upon his physician to tell him what and when to eat. The one is not likely to make a great success of living or the other of growing sweet potatoes. And this does not disparage the physician or the soil analyist. These have their places and their relations to healthful living and to economy in farming. The successful planter uses every aid, but lets nothing take the place of a personal acquaintance with his soil.

The truth of these principles is so obvious that any formal statement of them would seem superfluous if they were not so often ignored or slighted in the reports of experiments with fertilizers.

The sweet potato needs potash, nitrogen, and phosphoric acid. One of these elements of fertility is not more essential than another, but in point of quantity they are taken in the order here given. If either of them is not available in the soil in sufficient quantity it must be supplied or the crop will suffer. It is of importance to a planter to know approximately the deficiencies of his soil and how to supply these deficiencies at the least cost, and he can learn much from the experience of others without copying blindly.

A complete review of all published records of fertilizer experiments with sweet potatoes would be interesting and perhaps valuable, but the limits of this bulletin will not allow more than brief notices of a few of them.

EXPERIMENTS WITH FERTILIZERS.

A series of experiments, in some respects exceedingly interesting, has been conducted through a series of years on the Experiment Farm at Southern Pines, N. C. This farm is in a region of stunted pine and oak. The land is very sandy and very poor. There is no retentive subsoil. It parts with its moisture quickly, and loses plant food by leaching. The natural capacity of the soil is very low, as shown by the plats to which no fertilizers have been applied.

The object of the experiments is to show the effects of potash, nitrogen, phosphoric acid, and lime in different combinations and quantities. The potash is applied as sulphate, muriate, and kainit. The phosphoric acid comes from dissolved rock and the nitrogen from nitrate of soda. The experiments are altogether with inorganic fertilizers. No organic materials have been applied for several years.

The writer feels that he can not do better here than to quote from letters of Dr. Norman Robinson, now director of the Experiment Farm, with reference to the experiments of 1899 and 1900. The results of these experiments have not heretofore been published. Dr. Robinson writes, under date of November 30, 1900:

I have copied from our records a tabulated statement of crop productions last year, which was quite seasonable, and this, which was excessively dry. You will perhaps remember that when you were here (October 3) we found only "strings" and "culls" in the high-ground plats, which were also most liberally fertilized. I allowed them to remain in the ground as long as possible, or until November 13. By that time these roots had formed more or less tubers, as you will observe. One curious fact that I am at a loss to account for is that the unfertilized and partially fertilized plats bore larger crops this dry year than they did last, when moisture was abundant. Something may be due to the difference in variety. Last year we raised the "Hayman," this year the so-called "Red-nose," a yellow, mealy potato with a reddish tinge at the stem end.

Fertilized and unfertilized plats.—The statements referred to include records of nine of the twenty plats under cultivation. In response to further inquiries, Dr. Robinson on December 10 gave the records of plats 5 and 6 (which were especially desired because they had received no lime), as follows:

I selected those plats that I deemed of most interest. As to plat 12, from which the potato was taken that showed incipient decay, I found no more of this trouble in one plat than another. In other words, fertilization appears to have nothing to do with this fungoid trouble, whatever it may be.

As to plats 5 and 6, which have never been limed, the evidence this year is inconsistent with the theory that lime is required. And yet I am inclined to attribute the heavier yield rather to a better supply of moisture than to the absence of lime. The products of these two plats was as follows:

Record for 1900.

Plat 5, 244 pounds 4 ounces first grade, 195 pounds second grade, 155 pounds culls.
Plat 6, 240 pounds first grade, 159 pounds second grade, 149 pounds culls.

As these two plats are the best in the series, it might be assumed that the lime was deleterious in the other plats. Last year no such results were reached, as the following record shows:

Record for 1899.

Plat 5, 178 pounds 8 ounces first grade, 147 pounds second grade, 209 pounds culls.

Plat 6, 371 pounds first grade, 161 pounds second grade, 221 pounds culls.

As twelve other plats, some of them with no heavier fertilization, last year exceeded this product, it seems reasonable to conclude that some other cause may have determined this year's result.

One thing I have learned from my experience, here and elsewhere, is that it is not wise to come to too positive conclusions from the results of a single season's experimental work.

The following statement includes records of eleven plats for the years 1899 and 1900:

Crop of 1899.					Crop of 1900.				
Plat No.	Weight firsts.	Weight seconds.	Weight culls.	Bushels per acre.	Plat No.	Weight firsts.	Weight seconds.	Weight culls.	Bushels per acre.
	Lbs. oz.	*Lbs. oz.*	*Lbs. oz.*			*Lbs. oz.*	*Lbs. oz.*	*Lbs. oz.*	
1.....	87 4	18 4	14 4	43	1.....	91	168	100	128
2.....	85 8	30 4	80 12	70	2.....	195	190	114	178
3.....	60 4	46 4	126	83	3.....	117	192	104	144
4.....	250 4	91 8	148	175	4.....	177	185	166	169
5.....	178 8	147	209	191	5.....	244 4	195	155	212
6.....	371	161	221	269	6.....	240	159	149	196
7.....	17 8	35 4	64	43	7.....	36	74	78	67
10.....	603 4	251 4	174 4	367	10.....	114	148	171 8	154
18.....	558	250	142	329	18.....	163 4	132 8	135 12	154
19.....	1,010	286	120	505	19.....	121	146	236 4	179
20.....	1,320	286	154	630	20.....	83 8	138	255 8	170

The plats were fertilized as follows, the rate per acre being given:

(1) 50 pounds phosphoric acid; 40 pounds nitrogen; lime.
(2) 80 pounds potash; 40 pounds nitrogen; lime.
(3) 80 pounds potash; 50 pounds phosphoric acid; lime.
(4) 80 pounds potash; 50 pounds phosphoric acid; 40 pounds nitrogen; lime.
(5) 80 pounds potash; 50 pounds phosphoric acid; 40 pounds nitrogen.
(6) 80 pounds potash; 50 pounds phosphoric acid; 40 pounds nitrogen.
(7) No fertilization.
(10) 80 pounds potash; 50 pounds phosphoric acid; 40 pounds nitrogen; lime.
(18) 80 pounds potash; 50 pounds phosphoric acid; 80 pounds nitrogen; lime.
(19) 160 pounds potash; 100 pounds phosphoric acid; 80 pounds nitrogen; lime.
(20) 240 pounds potash; 150 pounds phosphoric acid; 120 pounds nitrogen; lime.

The normal ration in these experiments for 1 acre was 80 pounds potash from 160 pounds muriate of potash, or its equivalent in sulphate of potash or kainit; 50 pounds available phosphoric acid; 400 pounds acid phosphate; 40 pounds nitrogen from 250 pounds nitrate of soda.

The cost of a normal ration for 1 acre at ton prices would be about as follows: Potash, $3.50; nitrogen, $5.50; phosphoric acid, $2; total, $11.

The lime was applied at the rate of 2,000 pounds (slaked) in 1896. The other fertilizers have been applied annually.

Especial attention is given to this series of experiments because it is more complete than any other series of experiments with inorganic fertilizers known to the writer.

It will be noticed that the results here given are often inconsistent and inexplicable, and those of the previous years are equally so.

The contradictory character of the results must be attributed largely to inequalities of fertility and capacity to hold moisture in the several plats. In the report for 1896 the unfertilized plats, 7 and 13, are credited, respectively, with 39.5 pounds and 1.5 pounds of first-grade tubers. No other evidence is needed to show the unfitness of these plats for comparative fertilizer tests. Indeed the natural inequalities of the plats, those to which fertilizers were applied as well as those which received no fertilizers, is apparent to any practical planter who walks over them. It is exceedingly unfortunate that this elaborate series of experiments is handicapped in this way.

Good crops on poor soils.—Nevertheless, while much of the value that should attach to the experiments is lost, it is possible to draw some important conclusions. The most apparent of these is that good crops of sweet potatoes may be grown on very poor and very leachy soils without the addition of organic matter in any form. It is not likely that planters will use such lands so long as better lands are abundant and cheap, but the theory that a large amount of organic matter is necessary is successfully challenged, and it becomes important to consider how much of it is profitable. This is a question on which these experiments throw no light.

Inorganic fertilizers, under some conditions, injurious.—Another conclusion is that in a dry season inorganic fertilizers are likely to be injurious when applied to soils poor in organic matter in larger quantities than here noted as a normal ration. This is indicated in the record for 1900, which was an exceedingly dry season. In the growing season of 1899 heavy and frequent rains leached the dangerous surplus of these fertilizers out of the soil, and only so much was retained in the most heavily fertilized plats as the crop could use without injury. Hence the remarkable yield of these plats. In the partially fertilized, normally fertilized, and unfertilized plats there was no surplus, and the rains carried off plant food that was needed. Hence the low yield of these plats in that wet season. It seems probable that in soils well supplied with organic matter larger quantities of potash, nitrogen, and phosphoric acid may be used with safety and with profit than in soils poor in organic matter. This theory finds support in the practice of the most successful growers in Vineland, N. J. Their soil, though not rich in organic matter, is not nearly so poor as the soil of the plats at Southern Pines, and they apply more potash, nitrogen, and phosphoric acid than the "normal ration." The Vineland planters expend about $15 per acre for commercial fertilizers. When stable manure is bought the cost is greater.

It is to be regretted that the lime tests at Southern Pines warrant no conclusions.

Special Bulletin P of the New Jersey Agricultural Experiment Station is a record of "Experiments with fertilizers upon white and sweet potatoes." These experiments, unlike those of the Experiment Farm at Southern Pines, include organic fertilizers and stable manure. They were made in a section where sweet potatoes are grown largely for market, and under conditions which apply to ordinary field culture, and for these reasons will be found of particular interest.

Use of pine leaves.—In some parts of Delaware, Maryland, and Virginia pine leaves, otherwise called "pine shatters" and "pine straw," are used and valued highly by sweet-potato growers. The leaves are gathered in the pine woods, which abound in these sections, and applied like stable manure in furrows, where the ridges for the plants are afterwards made. Pine leaves and the wood mold which is collected with them are not rich in plant food, and on poor land they must be supplemented with more concentrated fertilizers.

The custom of using this material from the woods in sweet-potato farming is followed by many intelligent and successful planters. It would be difficult to convince them by argument, unsupported by practical demonstration, that this material is worth no more than the small amount of recognized plant food which it contains. And perhaps it would be equally difficult to furnish the demonstration. It is probable that an important function of this and other material similarly used is in conserving the moisture of the soil. It not only increases the capacity of the soil to hold water without injury to the plant, but, by breaking the continuity between the subsoil and the surface, it also prevents rapid evaporation in a dry time. The writer has had excellent results from a similar use of dry cornstalks. His method is to open broad furrows, 3½ feet apart from center to center, fill them with cornstalks, and throw the earth back over the stalks, thus making ridges on which the plants are set. Any concentrated fertilizers applied before planting should be well mixed with the soil, otherwise injury to the plants will follow. This is done cheaply and effectively by sowing the fertilizers broadcast before the ridges are made up. There is economy in applying nitrate of soda, which is very soluble, between the plants after transplanting. It is not necessary to cover it or mix with the soil. It must not be put on the plants or allowed to touch them.

PROPAGATION OF PLANTS.

Unlike the Irish potato, the sweet potato rarely blossoms and never matures seeds in northern latitudes, but in tropical and subtropical countries it performs this function as its relative, the morning glory, does in temperate regions.

Sweet potatoes, like Irish potatoes, may be propagated from seed to produce new varieties, but this is rarely done.

Improvement of stock.—Every sweet-potato grower has at hand the means to guard against deterioration and to improve his stock by a careful selection of tubers from plants of the best type for propagating, and he may establish new varieties of merit by propagating from sports, which frequently occur in sweet potatoes as in other plants. Many sweet-potato growers do not appreciate the opportunities that are open to them and practice a method of selection which tends toward deterioration rather than improvement. It is not uncommon to keep for propagating only the "roots" that can not be sold—anything that will produce sprouts. Hence plants that develop a tendency to run to roots rather than tubers have a large and increasing representation each year, whereas the product of such plants should be excluded entirely. One of the most careful and successful growers known to the writer is conducting a series of experiments by which it is hoped the benefits of selection on scientific principles will be clearly demonstrated.

Experiments have been made and reported to show the relative merits of large, medium, and small tubers for propagating with results that are neither consistent nor conclusive. It is safe to say, negatively, that tubers which command the highest price in market have not always or generally given better results than those of a smaller size. And it seems probable that the present prevailing practice among careful planters of propagating for the main crop from tubers of less than medium size will continue until it shall be shown to be unprofitable. It is to be hoped that a series of experiments to extend over several years and cover the whole subject of propagating the sweet potato shall be planned and conducted with such care and thoroughness, that the conclusions reached shall not be of doubtful value.

The direct method.—At the South pieces of the tuber are sometimes planted as Irish potatoes are planted at the North. This method is not practicable where the summers are short, or anywhere if the object is to produce an early crop, because pieces of sweet potato planted early, when the ground is not warm, are apt to rot without sprouting if the conditions of the soil and the weather do not prove to be especially favorable. Even at the South it is expensive, and there is little to recommend it. This is the direct method.

Indirect methods.—Two methods of propagating indirectly from tubers are employed. The first and more common method is to place the tubers close, without touching each other, in a hotbed or a cold frame, and cover with 2 or 3 inches of sand or loose earth that will not bake, about six weeks before the time for setting out plants. The tubers thus bedded throw up sprouts which put out roots, and so become individual plants ready to be transplanted to the field. These

rooted sprouts are carefully separated from the parent tuber without removing the tuber from the bed, and are set in rows in the field. The tubers continue to throw up sprouts which are used in later plantings. If tubers are more than an inch in diameter, they may be cut longitudinally, and the halves placed in the bed with the cut side down.[1]

The other method is to place the tubers in a bed as in the first method, only farther apart, or, later in the season, in rows in the field, without bottom heat or cover, and instead of separating the rooted slips from the tubers and transplanting them, they are allowed to produce vines from which cuttings are made and set in the field. This method is in common use at the South, where the summers are long, but it is not suited to more northern latitudes.

Slip seed.—Some planters, particularly in Delaware and Maryland, take cuttings from their vines in the field in June or July and plant them to produce small tubers which are used the next spring for propagating plants for the main crop. This product is called "slip seed" to distinguish it from "crop seed," by which is meant the small tubers of the regular crop, which are commonly used to produce plants. Some growers use only slip seed; others think they get as good results from well-selected crop seed.

Different varieties are not all equally prolific, but, as an average, a barrel of tubers, which are about an inch in diameter, and occupy 50 square feet of hot bed, should produce from 5,000 to 8,000 good plants in three or four weeks from the first drawing. Some planters bed more liberally, and set out the entire crop within ten days or two weeks. The later plants are then sold or discarded.

In plant houses.—Large growers propagate their plants in plant houses heated by furnaces and covered with muslin or "plant-bed cloth." After the sprouts appear the cover is rolled up or removed in fine weather to harden the plants before transplanting.

Good plants are sold at prices ranging from $1.25 to $2 per thousand, or $10 to $15 for 10,000.

Details of the construction and management of plant houses, hotbeds, and cold frames do not belong especially to a treatise on the sweet potato; hence they are not given here.

PREPARATION OF LAND.

Aside from the fertilization required the preparation of the light soils suitable for sweet potatoes is not expensive. No preceding crop puts the ground in better condition for sweet potatoes than clover; but a clover sod, or any sod, is apt to be infested with cutworms, and

[1] Some growers say that the later sprouts show no loss of vigor as compared with the first, and that they are of equal value with the first sprouts. It is more generally believed that the first sprouts are the best.

cutworms are troublesome and expensive in a sweet-potato field. An entomologist of some distinction once said to the writer that he had repeatedly warned farmers not to plant corn on sod land, and if they would persist in doing so they must expect to be troubled by cut worms. Yet farmers who have to practice a rotation of crops continue to plant corn on sod land. Fortunately for the sweet-potato grower he may expect good results from planting on land that has been under cultivation the preceding year, and so be more likely to escape a serious conflict with the cutworms. Such land does not always require plowing, and should never be plowed deeply. It will be understood that this applies to the light, loose soils described as being suitable for sweet potatoes. Harrowing with a disk or spading harrow may answer the purpose as well in some cases as plowing, and at less cost.

Planting on ridges.—Practical sweet-potato growers generally plant on ridges, the elevation varying from 2 to 12 inches. High ridges are most common on land that lacks drainage, and such land is not fit for sweet potatoes. Ordinarily the ridges are about 6 inches above the valleys. The ridges are made by throwing two furrows together with a turning plow, or with a disk cultivator, or a "hiller." If stable manure, pine leaves, or other bulky materials are used, they must be applied broadcast before the ridges are made or in furrows previously made where the ridges are to be thrown up. The ridges should be made high enough to allow for harrowing down with a light smoothing harrow. This is the last operation before planting, and destroys all weeds that have started.

The ridges for sweet potatoes should be 3 or 3½ feet from center to center, unless the aim is to grow the largest quantity possible per acre, in which case the width may be reduced to 2½ feet. The width last named is sufficient for the "vineless" or "bush" varieties.

PLANTING.

Where the plants are set in rows one way, only a distance of 18 inches between plants is recommended. When planted in checks for working both ways they must be at least 2 feet apart. The only advantage of planting in checks is that it saves something in hand labor on grassy ground.

How to set the plant.—A sweet potato plant should be set a little deeper in transplanting than it was in the plant bed, so that no part of the stem that was protected by earth in the bed shall be exposed in the field. For planting by hand the ground should be moist but not wet. If it is very dry the plants should be watered as soon as convenient after planting. Much of the vitality of plants is saved, particularly if the planting is done in sunshine and wind or when the ground is dry, by mudding or puddling the roots. This is done by

dipping them in a batter of the consistency of thick cream made of clay and water.

Men have been known to plant by hand, with the assistance of a boy to drop the plants, 10,000 plants in ten hours, but 5,000 may be considered a good average day's work.

Implements.—Various implements have been devised to obviate the necessity for stooping in hand planting. Chief among these are the "tongs," which are commonly used in New Jersey. A simple contrivance by which the plants are pushed into the loose ground at one movement is also used. There are several transplanting machines provided with water tanks from which each plant is watered automatically when it is set. These machines do excellent work, and make the planter independent of rain at the planting season. They are used for all kinds of vegetable plants, tobacco, small nursery stock, etc., and have separate attachments for planting Irish potatoes and for distributing fertilizers. One marked advantage in machine planting is that the ground is stirred and all weeds destroyed in the vicinity of the plants when they are set. This is often impossible in hand planting.

CULTIVATION.

Sweet potatoes require frequent cultivation and as much hand work as may be necessary to keep them free from weeds and grass until the vines take complete possession. If the work has been thoroughly done up to this time there will be no trouble with weeds and grass later. If it has been slighted, weeds will be seen rising above the sweet potato vines after they have covered the ground. All such weeds should be pulled by hand when the ground is soft after a rain.

Rooting of vines.—There has been much discussion in regard to the rooting of vines wherever they touch the ground, as their habit is. It has been supposed that the tendency of such rooting is to prevent a full development of the tubers, and much ingenuity and labor have been expended in trying to check or wholly prevent the rooting. It is now generally understood that the rooting of the vines does not hinder the development of the tubers, and that any violent interference with the vines is injurious. Sweet potato cultivators have steel rods attached which pass under the vines and lift them out of the way of the shovels without injury. After the last cultivating the vines are allowed to have their own way.

The critical period of a plant.—The most critical period in the life of a sweet potato plant begins when it is transplanted and ends when it begins to send out vigorous vines. It is only during this time that insect enemies are to be dreaded. The skillful grower will make this danger period short by using only strong plants, planting carefully in well-prepared ground, and cultivating thoroughly.

HARVESTING.

A small crop of sweet potatoes may be thrown out by a common turning plow provided with a revolving coulter or other device for cutting the vines, but such a plow leaves many of the tubers covered, and the labor of gathering them is much greater than when a special sweet potato plow is used. In large operations one of the most efficient implements for harvesting is the "scoop digger," which passes under the tubers and severs all roots, but leaves the plant, with vines and roots cut, in the same position it occupied before. The tubers remain attached to the stem and are easily and rapidly lifted out of the ground. They are then left to dry several hours before gathering. In hot weather they should not be long exposed to the sun. This method leaves the vines uncovered, and it is easy to gather them for stock feeding. The tubers are sorted in two sizes and laid carefully (not thrown) into baskets which hold one-fifth of a barrel. They are hauled in these baskets to the potato house, or to the buyer at the railroad station or steamboat landing. The small roots are left on the field or gathered for feeding stock. It is of prime importance to avoid cutting the tubers in digging or bruising them afterwards by rough handling.

The yield of sweet potatoes varies widely according to variety, quality of land, season, fertilizers, culture, etc. Under favorable conditions, in check planting a barrel of primes from 100 hills is a good yield, or a barrel from 125 plants 18 inches apart in a row. In a good crop there may be a barrel of seconds to every 5 barrels of primes, more or less, according to the method of sorting. Extremes of yield go far above and drop as far below the figures here given.

It will be understood that only sweet potatoes of good quality for table use are referred to in this estimate. Some of the coarser varieties used for stock feeding, or even the finer varieties grown in rich land, where they are apt to be deficient in quality, may be expected to yield 400 or 500 bushels per acre.

SHIPPING.

Sweet potatoes do not bear rough handling, and for this reason they are more commonly shipped in packages than in bulk, as are Irish potatoes. Barrels are preferred, but many are shipped in half-barrel crates, particularly early in the season. Secondhand flour barrels and new and secondhand produce barrels are commonly used. They vary in cost, according to quality, supply, and demand, from 5 to 20 cents each. New half-barrel crates cost in small lots from 12 to 15 cents each.

In barrels.—In packing sweet potatoes in barrels, the barrels are filled loosely and covered with burlap, or "double-headed" under

pressure, as apples are packed for shipment. "Prime," "Select," and "Fancy" brands are packed under pressure and double-headed, while the cheaper grades in the market are found under cloth covers. A barrel packed under pressure holds a peck more of sweet potatoes than a barrel of the same size loosely filled. Adding the value of a peck of sweet potatoes to the extra cost of a better barrel and double heading, the former should sell for 25 cents more than the latter when sweet potatoes are worth 50 cents a bushel at the shipping point. This assumes that the sweet potatoes in the two barrels are of the same grade. Anyone who consults the market reports of the large cities will see that the difference per barrel between grades called "Jersey Sweets," which are double-headed, and those classed as "Southern Sweets," which are cloth covered, as often exceeds as it falls below $1.

Causes of differences in values.—Let us look more closely into the causes of this remarkable difference in values, which is hardly less than the whole cost of production. It will not be contended seriously that any small section or State has a monopoly of the conditions requisite for producing sweet potatoes of the best quality. "Jersey Sweets" do not command the best price because they are produced in New Jersey. Many of them do not even pass through that State on their way to the market, and no better sweet potatoes are produced anywhere than in the Southern States. These States get more discredit than justly belongs to them from the cheap "Southern Sweets." The truth seems to be that some enterprising growers in New Jersey took the lead in adopting standards of appearance and quality, in grading uniformly and packing carefully, in giving their best product a distinctive name, and putting it on the market in the best possible condition, with the grower's name or initials on each package. When Jersey-grown sweet potatoes are inferior, they go into the market without name or initials, and any deficiency in quantity of "Prime Jersey Sweets" is more than made up by first-class stock from other States. Buyers understand that "Jersey Sweets," on which the grower has put his name, are uniform throughout the barrel with the single exception that a layer of selected tubers is placed on the bottom of the barrel in packing, which appears on the top when the barrel is opened.

Grading.—Those who ship "Southern Sweets" from whatever section give little or no attention to grading, and their stock reaches market abraded and bruised from jolting in loosely-filled barrels. In addition to the 25 cents before noted as the extra cost of double-heading, they save, at an outside estimate, 25 cents a barrel in labor and material by allowing 3 pecks of seconds and culls to go into each barrel. This shows a total saving of 50 cents, which results in a loss of $1 on each barrel.

Sweet potatoes are shipped in bulk and in packages from New Jersey to Chicago and farther West, and as great distances in other directions, and experimental shipments have been made to Europe, which will be referred to more particularly in another part of this bulletin (p. 29).

MARKETS AND PRICES.

Commissions.—Sweet potatoes that reach market by rail or water transportation are sold, as a rule, by produce commission merchants, who charge from 5 to 10 per cent for their services. In sweet potato districts local merchants are supplied largely by neighboring farmers. The farmer with a home market always has an advantage over one who must pay not only freights but commissions for services which are not always honestly and efficiently rendered. The disadvantages of transporting to and selling in distant markets are reduced to a minimum when farmers organize and sell through a common agent. This truth is illustrated in the history of a produce exchange on the Eastern Shore of Virginia. The two counties of the Eastern Shore of Virginia produce large quantities of sweet potatoes. Before the formation of the exchange the crop was put up in a careless way, without grading, and sold without inspection. The prices obtained were necessarily very low and the whole business was unsatisfactory in the extreme. The exchange was organized with a central office and management, and with subagents at all principal shipping points in the two counties, the subagents having connection by telephone with the central office. A system of inspection was adopted, produce was graded, dishonest sellers were excluded, favorable arrangements were made with transportation companies, correspondence was opened with reliable commission houses, market reports were received by telegraph, and business principles were applied generally. In less than two years a good degree of order has taken the place of former chaos.

Careless packing.—In other parts of Virginia, in North Carolina, and in some of the best sweet-potato sections of Maryland the old careless ways prevail, with results that must be exceedingly unsatisfactory to growers. A New York market report of November 17 quotes "Jersey Sweets," $1.50 to $2.50; "Southern Sweets," $1.12 to $1.25. A week later the report was "Jersey Sweets," $1.50 to $2.25; "Southern Sweets," 60 to 90 cents. A better illustration of the cost of unbusinesslike methods can not be found. The highest prices here noted for choice Jerseys is rather low for the last half of November in New York, but they allow a small profit. The grower of the "Southern Sweets," after paying for barrels, freights, and commissions, had 40 or 50 cents for a barrel of potatoes delivered to railroad or steamboat at the prices first noted. A week later, under heavy shipments, prices were depressed. The "Jerseys" lost 10 per cent on extreme prices; the

others did not pay expenses of transportation and sale. The grower prepared his land, paid for his fertilizers, provided plants, planted, cultivated, harvested, and shipped his crop, and got—nothing. It might be difficult to convince a Jerseyman that "Southern Sweets" are intrinsically as good as "Jersey Sweets," but then it would be equally difficult to convince a Southern man of the truth of the reverse. Each grower would claim that his potatoes are better than the others. The essential point is that the Southern man can produce as good potatoes as the Jerseyman,[1] and at as small cost. When nature has done her part for both, one goes to work in a systematic way, separates his marketable potatoes into two sizes, packs them carefully in full-sized barrels, puts in a wooden head under pressure, stencils his initials on the barrel, sends it to market, and puts money in bank. The other is careless in his packing. He saves something on barrel, cover, labor, and potatoes, but on the whole operation when he strikes a full market he loses time, labor, and money. But the market is not always low, so he does not always lose money on a year's operations.

The sweet potatoes shipped to Northern markets from points south of Wilmington, N. C., in the Atlantic region are insignificant in quantity, although they are produced in large quantities for local markets and for stock feeding. Similar conditions prevail in the Mississippi Valley. The markets above the line of general sweet-potato culture are supplied from the East, and from the middle West—not from the South. Sweet potatoes are produced very cheaply on the rich lands of the Mississippi Valley, but they do not stand in market with Eastern sweet potatoes, or with those grown on thin lands in the middle West.

Times of highest and lowest prices.—The New York market is generally supplied with sweet potatoes about ten months in the year, from August to May, inclusive. The highest prices are obtained early in the season, the yield being then comparatively light, for the tubers have not then finished their growth. By the middle of August the supply is liberal and prices decline until the lowest level is reached in October or November. After that prices are likely to advance slowly to compensate for shrinkage, loss in storing, and the extra risk attending winter shipments. The advance does not always begin before the 1st of January, and is not always maintained through the winter.

STORAGE.

The sweet potato is a tropical or subtropical plant. Where frost never comes it is perennial and the question of storing does not enter.

[1] It is worthy of note that at the date of this writing, December 22, 1900, a few North Carolina growers are taking the highest prices in the Baltimore and Washington markets for sweet potatoes in burlap-covered barrels. Sweet potatoes rarely come to these markets, or to any markets in sweet-potato growing sections in double-headed barrels.

In nearly all parts of the United States it must be treated as an exotic, and where the winters are long and severe the question of storing the tubers becomes very important. In sections where frosts never penetrate the ground more than a few inches, sweet potatoes are stored in mounds on well-drained land, and covered with leaves, straw, or cornstalks, and, as cold weather approaches, a blanket of earth is added. A temporary roof of boards is sometimes placed over the mounds to shed the rain. In some places low huts are built of logs and slabs and covered with earth. These methods are primitive and unsatisfactory, and when losses are considered, they are expensive. They are still commonly practiced south of the Potomac River, though some of the more enterprising growers are adopting modifications of the methods now employed in Maryland, Delaware, New Jersey, the Eastern Shore of Virginia, and other sections where sweet potatoes are stored in large quantities for winter and spring markets. In the southern Piedmont region sweet potatoes are sometimes stored in caves, natural or artificial, and with good results. These methods have been in use at the South for generations without essential change.

It was an old custom at the North, where small patches of sweet potatoes were cultivated for home use, to use them freely in the fall, and at the approach of winter pack a choice remnant in boxes or barrels with chaff or sand, and give them a safe place in the kitchen loft close to the chimney, for use only on special occasions or as a contribution to the Christmas feast of a neighbor or friend.

In what may be called the commercial sweet-potato belt, the methods of storing have been revolutionized within thirty years. Before the civil war the Northern cities had no regular supply of sweet potatoes, and with the methods of storing then followed, such a supply would not have been practicable. Whether the adoption of better methods of storing is the cause or a result of a greatly increased demand for sweet potatoes is not important. It is sufficient to note that with improved methods of storing we have a more uniform supply and a larger demand.

In cellar or storehouse.—In the commercial sweet-potato belt we now find them stored in large quantities in dry, warm cellars or houses especially built for them on the farm or at the railroad station or steamboat landing. The grower who stores his crop generally has his own cellar or storehouse on the farm. Sometimes a dealer provides a large storehouse at the shipping point for his own use and to rent room to growers at a fixed price per bin or barrel; or an association of growers may have a house for the use of its members. The capacity of the storage room or house may be small or large. A grower may keep 100 bushels in his cellar or hire a bin in a house that stores 10,000 or 12,000 barrels. Sweet potatoes may be stored 10 feet deep in bins without injury. An air space is always left open between the bins and the outer walls.

The conditions of successful storing as now understood are (1) healthy tubers that are not cut or bruised; (2) the evaporation and removal of more or less water during "the sweating process;" (3) after the sweating a dry air with guarded ventilation and a uniform temperature, neither below 50° nor above 65° F.; (4) exclusion of rats and other destructive vermin.

These conditions, if we except the requirement of perfectly healthy tubers, are not difficult. Loss from various forms of disease is considerable, but no greater than in other branches of agriculture, and such losses as occur should be charged up without the added cost of storing. A careful grower is not likely to put in storage many infected or unsound tubers. A crop that shows indications of disease should be disposed of in the fall. Cut or bruised tubers should never be stored. It is better to sell them for what they will bring or feed to stock.

Treatment during sweating period.—Intelligent growers differ as to the best treatment of sweet potatoes during the sweating period, the difference being rather as to means than end. It is now generally believed to be desirable to get rid of a part of the water in the sweet potato soon after, if not before, it is stored. A method common among large growers has been, and still is, to keep the storage room at about 90° F. while it is being filled, and afterwards as long as no indications of sprouting are seen—a period of a week or ten days or two weeks. During this time free ventilation is provided to carry off the evaporated moisture. After this no artificial heat is required excepting to keep the temperature above 50°. Potatoes treated in this way are said to be kiln-dried.

A difficulty attending this high-temperature method is that it necessitates storing the potatoes more rapidly than is always convenient, for if the work lingers the first are apt to be sweated too much or the last too little. Whatever the merits of this method, it is found very difficult of application to large crops or in large storehouses, and the tendency now is to allow the sweating to proceed more slowly at a lower temperature. The filling of some large houses occupies several weeks. and during this time, generally in October, the houses are thrown open in pleasant weather for free circulation of air, and but little artificial heat is applied. It is claimed by those who store in this way that it is not only more convenient but in every respect better than the high-temperature method.

Cellars, excepting in very porous and well-drained soils, are likely to be damp, and for this reason unsuitable for storing sweet potatoes, unless the walls and floor are cemented.

Air moisture must be considered no less than ground moisture. Ventilation is necessary, but not at all times. When the tubers are cool, particularly if stored in bulk, they will soon become damp and wet in a current of warm air by condensation of the moisture of the

air on the tubers. Warm air must be excluded from cool sweet potatoes, unless the air be dry as well as warm.

It is not always possible to exclude vermin, but danger is reduced to a minimum by allowing a good cat access to the storeroom. Where road dust or sand is used for packing, rats and mice do not make much progress in burrowing.

The sweet potato has become popular far beyond the limits of its successful and profitable culture. The present importance of the crop and the prospect now opening of a greatly increased demand, not only for the raw potatoes, but for the canned and desiccated products, emphasize the necessity for understanding and practicing the best methods of storing. Some who store in a small way fill the interstices between the tubers with dry sand or road dust, and in this way they are kept in excellent condition until the new crop is ready for use the next summer. Earth, sand, or other dry packing secures a more uniform temperature than is possible otherwise, prevents excessive evaporation, and tends to prevent the spread of disease from unsound tubers. It is prudent to use fresh packing every year.

Dry packing.—The use of dry packing, while neither new nor confined to any particular section, is worthy of careful study as a means of preserving the tubers throughout the year without deterioration.

Until recently storing in packages for subsequent shipment has not been thought practicable, but this method has been tried with encouraging results, and is likely to come into general use. Half-barrel crates are particularly adapted to this method of storing.

The transportation of sweet potatoes over long distances in cold weather is attended with extra expense and a degree of risk, which makes them costly to the consumer. Consequently such shipments are to be avoided. There is little reason to doubt that sweet potatoes carefully packed in crates or ventilated barrels when harvested may be shipped long distances in the mild weather of fall and stored at their destination for winter and spring use. If this be found practicable the problem of supplying our most northern cities and towns and the markets of Canada becomes very easy. The same method will apply equally well to shipments across the ocean. The cost of sweet potatoes to consumers in Europe through shipping in large quantities—perhaps in full cargoes, and with a minimum of risk—would be so greatly reduced that a very large demand for them might reasonably be expected to follow.

CANNED AND DESICCATED SWEET POTATOES AND SWEET-POTATO FLOUR.

The canning of sweet potatoes, although a new industry, has reached a considerable degree of importance in several States. The smaller tubers known as seconds are preferred for canning. They are put up

in 3-pound tins, which are packed in cases holding 2 dozen each. A good market is found for this product where sweet potatoes in their raw state are not accessible, particularly in winter. They are in favor in lumber and mining camps at the North, and some have been shipped to our soldiers in the Philippines.

Sweet potatoes have been dried in a small way for family use as fruits are dried, but the desiccation of sweet potatoes in a commercial way has not yet been attempted. Several patents have been issued recently covering processes and machinery for desiccating sweet potatoes and for making sweet-potato flour, and the owners of these patents are confident of soon being able to put their products on the market. Analyses of samples recently examined by the Division of Chemistry of the Department of Agriculture are here given:

Results of analysis of desiccated sweet potato.

	Per cent.		Per cent.
Moisture	10.46	Starch	46.22
Fat (ether extract)	1.18	Dextrose	18.55
Fiber	1.91	Sucrose	10.93
Ash	3.04	Undetermined	3.21
Protein	4.50		

Results of analysis of sweet-potato flour.

	Per cent.		Per cent.
Moisture	11.33	Glucose	10.75
Fat	.62	Sucrose	19.61
Fiber	2.21	Protein	1.94
Ash	1.84	Undetermined	1.67
Starch	50.03		

The inventors claim that their products are highly nutritious and palatable in a variety of forms; that they can be manufactured very cheaply, transported long distances at small cost, and kept in any climate. Practical success in this direction would, while benefiting directly the agricultural interests of a large section of the country, put a new and valuable staple food on our markets at prices within the reach of all, and open the way for a large export trade.

HOW TO COOK SWEET POTATOES.

The delicate flavor of a sweet potato is lost if it is not cooked properly. Steaming develops and preserves the flavor better than boiling, and baking better than steaming.

A sweet potato cooked quickly is not well cooked. Time is an essential element. Twenty minutes may serve to bake a sweet potato so that a hungry man can eat it, but if flavor is an object, it should be kept in the oven an hour. The negroes of the South have a way of baking sweet potatoes in ashes covered with coals. They are often put in the ashes after one meal and left there while the negroes are

working in the field, to be ready for the next meal. Hence, their fine flavor.

Experiments in baking kiln-dried sweet potatoes have been made to compare the results of different periods of baking in palatability, and to note the loss of weight in different periods. Tubers of medium and uniform size were weighed before placing in the oven, and after baking twenty minutes, forty minutes, and sixty minutes. Similar tubers were weighed and put in the oven after the others had baked forty minutes. All were baked through at the end of the hour. Contrary to a common supposition that long baking makes a sweet potato dry, it was found that those which were baked an hour were in appearance and to the taste moister than those which were baked only twenty minutes, notwithstanding a greater loss of weight in baking, and those which were baked a full hour in the oven were incomparably more palatable than the others. The average loss of weight was as follows:

First twenty minutes, 5.3 per cent; second twenty minutes, 8.4 per cent; third twenty minutes, 11.4 per cent.

The baking was not continued longer than an hour in any case.

The following recipes give the best methods of cooking sweet potatoes:

Boiled or steamed.—Boil or steam like white potatoes and without breaking the skin. If boiled, pour off the water as soon as done, cover the pot with a cloth and let it stand on the back part of the range a few minutes before serving.

Baked.—Bake like white potatoes, without breaking the skin. When done, break the skin in one place in the form of a cross, forcing the meat partly out, cap with butter and serve.

Baked in ashes.—The negroes of the Southern States bake sweet potatoes in ashes, and many persons think the best flavor is secured in this way.

Browned.—Cut cold, boiled, or steamed sweet potatoes into slices one-fourth of an inch thick; add butter, sugar, pepper, and salt, and put into a hot oven to brown.

Puree.—Mash boiled, steamed, or baked sweet potatoes, season, and add enough hot milk to moisten; serve like mashed white potato; or put in pudding dish, dress the top with egg, and brown in the oven. Serve with sauce.

Croquettes.—Take two cupfuls of mashed, boiled, steamed, or baked sweet potatoes; add the beaten yolks of two eggs and season to taste; stir over the fire until the mass parts from the sides of the pan. When cold form into small croquettes, roll in egg and bread crumbs, and fry in hot lard to an amber color. Serve on napkins. The croquette mixture may be made into balls inclosing minced meat. When used in this way serve with sauce.

A Southern dish.—Cut cold baked sweet potatoes into slices and put into an earthern dish; add sugar and butter to each layer and bake until slightly browned.

Stuffed.—Bake; then cut off one end and scoop out the inside; season with butter, pepper, and salt; beat until light; replace in the skin; close with the piece cut off and put into the oven to heat through. Serve in napkins. Suitable for luncheon.

Broiled.—Steam, pare, and cut in slices three-eighths of an inch thick; lay the slices in a double broiler; salt, cover with melted butter, and broil over a slow fire; serve in folded napkins.

With roast beef.—Roast the beef and make a brown gravy. Take sweet potatoes of medium size, previously baked, remove the skin, and garnish the dish with the potatoes. Serve the potatoes with the beef.

Glacé.—Boil and cut in halves medium-sized sweet potatoes, lay evenly in braising pan, baste with sirup and butter warmed together, sprinkle lightly with brown sugar, put in hot oven till brown, and serve in the sirup.

Another glacé.—Cut in slices one-half inch thick, wash, and place in deep saucepan spread with butter, season with a little grated nutmeg and salt; moisten with broth or water, cover and let simmer over slow fire for three-quarters of an hour, turning the slices so that they may glaze on both sides. Serve with drawn butter or other sauce.

Fried.—Cut in slices lengthwise and fry in deep grease, same as white potatoes.

Pie.—Boil in skins; when tender remove skins, mash and beat until light; to each pint add a pint of milk and four eggs. Season and bake as pumpkin pie.

EXPORTATION OF SWEET POTATOES.

In the winter of 1899–1900, the writer, as secretary of the Vansville Farmers' Club of Maryland, undertook an investigation with a view to introducing sweet potatoes into foreign markets. It was learned that sweet potatoes are not produced to any considerable extent in Europe. They are planted in a small way in the south of Spain, but have not become a staple crop in any European country, nor are they imported except as a luxury. The small quantities imported in European countries have come from the south of Spain, the Canary Islands, and Africa. Inquiries at the Treasury Department, the Statistical Division of the Department of Agriculture, the produce exchanges of several cities, and many exporting houses, gave no clue to exports from the United States prior to 1900. From other sources it was learned that a few barrels had been shipped as gifts to friends. These did not appear in the markets.

In response to inquiries, an American living in London wrote as follows:

The English people are not educated up to the delicacy of the sweet potato as grown in the Southern States of America, because those known in this country come mainly from the Canary Islands, and are a poor, wet, and soggy product.

There are about 50,000 permanent American residents in London, and if they could buy a good article at a moderate price there is no doubt they would do so, and from the Americans the English might learn to like them.

Many American products have met with a large sale in England by being energetically pushed, and I see no reason why sweet potatoes should not have a good sale if handled in the same way.

AMERICAN SWEET POTATOES IN EUROPE.

The facts so far as ascertained were laid before the Secretary of Agriculture in March, 1900, and he directed that trial shipments be made to London and Paris. The following account of this first serious attempt at exporting sweet potatoes was issued August 22, 1900, by the Department:

The Secretary of Agriculture has received from Dr. D. E. Salmon, Chief of the Bureau of Animal Industry, a report on a trial shipment of sweet potatoes to London, England, and Paris, France, made last March, by direction of the Secretary, for the purpose of securing some facts as to the possibility of introducing this American product into European markets.

The middle of last March 20 barrels of sweet potatoes were purchased in southern New Jersey, to be exported in two lots of 10 barrels each to London and Paris. Special care was taken both in the selection and packing of the potatoes. The barrels were lined with tar paper to keep out moisture, and each potato was wrapped in light-weight parchment paper. The potatoes were selected and instructions for shipment were given by Mr. D. M. Nesbit, secretary of the Vansville Farmers' Club of Maryland, which has given much attention to the cultivation and marketing of sweet potatoes.

The lot was shipped by the Red Star steamship *Kensington*, which sailed for Southampton March 21, and a special request was made that the shipment be placed in a cool and dry part of the vessel.

At Southampton 10 barrels were sent to Dr. W. H. Wray, inspector of the Bureau at London, and the remaining 10 barrels were forwarded to Mr. William A. Taylor, Assistant Pomologist of the Department, then in Paris, in charge of the United States horticultural exhibit at the Exposition.

The 10 barrels arrived in London April 2. Seven barrels were sent to four different stores and three distributed, in small parcels, to private families. The experiment being made by the Department was explained, and an expression as to how the potatoes were liked was requested. Some dealers were invited to give opinions as to the advisability of making regular shipments.

In reporting the results of the experiment based on personal observation and replies to the requests sent with the potatoes, Dr. Wray states that the potatoes were beautifully packed, but it was late in the season for them, and in two of the barrels, which he saw opened, were quite a number of rotten ones.

Many persons with whom he talked had never before eaten American sweet potatoes, and the first impression of them was not favorable, but after a second and third trial they were voted very palatable. Dr. Wray is strongly of the opinion that if sweet potatoes are introduced through the proper channels they

will find a considerable sale in the English market. He says to introduce them it will be necessary to educate the Britisher up to them, and that it would be advisable to have printed a small circular giving the various recipes for cooking and serving. He recommends that shipments of, say, six barrels per week be made, and, if the demand warrants, this number can easily be increased by cable. There are many American families residing permanently in England, and by advertising the fact that sweet potatoes were obtainable a considerable sale would be insured from the start.

The potatoes were retailed at different stores at 4d., 3d., and 2d. per pound. They were readily bought up, mostly by Americans, who would probably have paid double those prices for the few obtainable.

Dr. Wray strongly urges the Department to continue the experiment, and believes that a remunerative trade in sweet potatoes can be built up in England. Several dealers have expressed a wish for further supplies, and it has been suggested that holes be made in the barrels for ventilation.

Mr. William A. Taylor, Assistant Pomologist, reports that the ten barrels of sweet potatoes shipped to him were discharged at Southampton, and after being held there some days he was notified by the forwarding agent at Southampton that the French customs officer at Havre refused to permit the shipment to enter his port, on the ground that all potatoes from America were prohibited entry to France by an official decree. Directions were then given to forward the consignment as "yams," which are not prohibited entry. The goods reached the Exposition April 20.

Upon opening the barrels the contents of most of them were found to be in bad condition. With the exception of two barrels the potatoes had apparently been chilled, and in some at least one-third of the specimens were rotten. About five barrels of the best stock was displayed April 21, and Mr. Taylor requested jury consideration, but this was not granted, because the exhibit was received after the jury had completed its work for the horticultural competition.

The exhibit aroused much interest, as was evidenced by inquiries of persons who viewed it, few of whom recognized the articles shown. Some of the leading dealers expressed the opinion that a trade could be built up, provided it could be demonstrated that shipments would reach the market in sound condition.

General distribution of specimens for testing was impracticable, because, like other exhibits, they were in bond and their distribution prohibited by the customs authorities. The quality had been so much injured by chilling that Mr. Taylor considered it unwise to attempt to secure removal of this prohibition, for the distribution of specimens in such condition would have been unfair to the quality of American sweet potatoes in general.

So long as the present prohibition of American potatoes continues they can be imported only as "yams." Yams are dutiable at 8 francs per 100 kilograms, which is equal to about 70 cents per 100 pounds. The cost of transportation from New York to Paris would be about $2 per barrel, and the price that could be obtained for sound stock in limited quantity would be about 8 or 10 cents per pound.

The Paris market for novelties in fruits and vegetables is excellent, and prices paid are very high. Mr. Taylor thinks it quite probable that if small shipments of choice sweet potatoes could be made regularly, under conditions that would insure their delivery in sound condition, a trade of considerable proportions could be built up.

Encouraging results.—It will be noticed that this shipment was made nearly at the end of the sweet potato season. The results, although not entirely satisfactory, were sufficiently encouraging to warrant further efforts, and a series of shipments from the crop of 1900 was undertaken, the first being made from the Eastern Shore of Virginia on the

3d of October. Other shipments have followed at intervals during October, November, and December from Virginia, New Jersey, and Maryland.

The object has been not only to introduce our sweet potatoes in England, but to test several questions connected with shipment and storage after shipment. A trial shipment of canned sweet potatoes has also been made. At the time of this writing it would be impossible to make a complete statement in regard to the experiments in exportation, and it is thought better to await the results of what has been done and of further efforts in this direction that are contemplated.

DISEASES AND INSECT ENEMIES.

These subjects have been taken up in several of the State experiment stations and treated in their publications with a degree of thoroughness that would be impossible within the limits of this bulletin. Little more than an enumeration of the most destructive fungus diseases and insect enemies will be attempted here.

FUNGUS DISEASES.

The following summary is from "Some Diseases of the Sweet Potato and how to Treat Them," which appears as Bulletin No. 60 of the Maryland Agricultural Experiment Station:

Black rot.—Both stem and root liable to be attacked by this disease. Causes the diseased part to turn black, as the name signifies. May attack the young sets in the bed or it may not appear until the plants are in the field.

Remedy.—Discard all diseased sets, spray with Bordeaux mixture if an attack is feared, and do not plant in the same field where the disease appeared last season.

Soil rot.—Attack is confined to the roots and tubers, giving to them the appearance of a string of beads of irregular size and shape.

Remedy.—Rotate crops. Treat the soil with sulphur 400 pounds to the acre, sowed broadcast, and worked in. To the sulphur may be added with advantage the same amount of kainit.

Soft rot.—Attacks tubers, usually after they are stored. Tubers shrivel. Black masses when skin is broken and disagreeable odor.

Remedy.—Avoid bruising the tubers, store in dry places at a temperature of about 70 degrees, remove and burn diseased tubers as soon as they begin to decay.

Stem rot.—Dark lines appear on the stem just at the surface of the ground. Vine turns yellow, then black throughout, unless rooted at some node, beyond which it remains green. Disease extends downward, and causes upper part of tuber to decay. Short shoots from partly decayed tubers.

Remedy.—Rotate crops. Use only vigorous sets.

White rot.—Attacks tubers only, giving them a white, chalky appearance.

Remedy.—Rotate crops. Use only vigorous sets.

Dry rot.—Attacks underground parts only, giving to them a wrinkled, pimply appearance. Interior of diseased tubers becomes dry and powdery.

Remedy.—Gather and burn all diseased roots at the time the crop is harvested.

Scurf.—Attacks underground portion only, giving to them a rough, brownish, and sometimes a shriveled appearance.

Remedy.—Discard all diseased tubers in producing sets and rotate crops.

Leaf mold.—Leaves become sickly, brown spots appear upon their upper surfaces, and white spots upon the under surface.

Remedy.—Destroy all related weeds. Spray with Bordeaux mixture.

INJURIOUS INSECTS.

Insects injurious to the sweet potato have been grouped according to the part of the plant which they attack. The most destructive of these are—

Leaf eaters.—This group includes the flea-beetle, the tortoise beetles of several species, the sawfly, the plume moth, and others of minor importance. The beetles often feed on the young plants soon after they are set out and before they have become firmly rooted. In the weak condition of plants at this period the attacks of the beetles are particularly destructive. The beetles continue feeding on the foliage after the plants have become well established and put out vigorous vines, but they are to be feared only when the plants are small.

It is recommended to dip the plants before transplanting in a solution of arsenate of lead, which is made by dissolving a half ounce acetate of lead and three-sixteenths of an ounce arsenate of soda in four and a half gallons of water. If five tablespoonfuls of glucose or molasses are added the mixture will adhere better. It should be kept well stirred when in use. If no such precaution is taken at the time of transplanting, the plants may be sprayed afterwards with an arsenical mixture, but this is more expensive and less efficacious. (See Farmers' Bulletins Nos. 19 and 127.)

Depredations of the larvæ of the sawfly and plume moth have been local and confined to a few sections. They are apt to occur after the plant has passed the most trying stage of its life, and are not generally very serious. If the larvæ should be troublesome they may be held in check by spraying with Paris green.

Stem cutters.—These are the well-known cutworms. They are of several species and all very troublesome, particularly in sod land. The cutworms hibernate during the winter and eat voraciously during the early spring. They, like the beetles, are more destructive soon after the plants are set out than at any other time. Where they are numerous much loss is avoided by poisoning them before transplanting. This may be done by spraying a plat of grass with a mixture of 1 ounce of paris green to 5 gallons of water, mowing the grass, and dropping it in handfuls on the ground to be planted at intervals of five or six yards. Many of the worms are attracted to the grass and poisoned. The cutworms feed at night and prefer fresh food. For this reason the poisoned grass should be distributed on the field in the evening.

Root borer or weevil, which feeds upon and breeds in the roots and tubers, has been very destructive in some portions of the Gulf

States, but not elsewhere in the United States. Great care should be taken with seed from sections in which this pest has been found, although, as it came to the United States from the West Indies and South America, it may not flourish far north of the Gulf of Mexico. Such seed may be fumigated like nursery stock, but it would be safer to avoid the use of it altogether. No successful method of combating this insect when it has gained a foothold is known.

SWEET POTATOES FOR STOCK FEEDING.

The success of many modern productive industries depends on the utilization of by-products. For obvious reasons this principle is more generally recognized and acted upon in those industries which require or invite large investments of capital than in ordinary farming operations. The meat packers of Chicago could not have built up their immense fortunes while rendering good service to consumers if they had looked only to their meat, fat, and hide products and neglected the hoofs and horns and bones, the glue and blood and tankage. The manufacturers of flour and other well-known cereal food products are equally dependent upon their by-products; and cotton-seed, itself a by-product of cotton planting, which only a few years ago planters allowed to rot at the gin house, now yields an immense value in oil, and the secondary by-products of lint and hulls and meal, which no manufacturer would think for a moment of wasting.

BY-PRODUCTS.

The raw material of these and many other manufacturing industries comes from the soil, and the farmer and stockman are supposed to get their share of the value of the by-products when they sell their crops.

There are other valuable by-products of the farm which the farmer can not sell. He must work them up on the farm or allow them to go to waste. Among these are the culls and vines of the sweet potato crop. It is doubtless true that these culls and vines have some value as fertilizers, and if allowed to rot on the ground their value is not entirely lost. It is equally true that some old-time cotton planters hauled cotton seed from the gin house and applied it as a fertilizer for the next crop, thus saving a small part of its value. Such economy was wasteful in its time, and is now quite out of date. We shall therefore not discuss the fertilizing value of sweet-potato culls and vines left on the field.

The quantity of culls and vines produced with a crop of sweet potatoes depends on the same conditions that determine the main crop, but in a less degree. The planter is sure of the by-product whether he gets a good marketable crop or not. For the present purpose it may be assumed that an acre of sweet potatoes will yield a ton of culls and 4 tons of vines.

Hay.—Sweet-potato vines make a fair quality of hay and are palatable to most kinds of stock. The greatest objection to their use is the difficulty of curing them in good condition. Sweet-potato vines would probably make good silage also. For this it will be necessary, as with cowpeas, to let the vines wilt thoroughly before putting them in the silo, or the product will be slimy and unpalatable.

Culls.—A ton of culls, consisting of the small roots, which are unsalable, and the misshapen, damaged, or otherwise defective tubers, which have little or no net value in the market, does not differ much in value for stock feeding from a ton of marketable tubers. Analyses of sweet potatoes show a greater food value in them than in equal quantities of any other roots which are commonly fed to stock. Irish potatoes are far below them in value. But analytical examinations of food stuffs can not take account of the tastes and preferences of stock and other considerations which have a part in determining the availability of any food stuff.

FEEDING VALUE.

A comparison of values of the dry matter of roots with the dry matter of hay or other dried fodder does not determine the feeding value of the roots. We do not feed dried roots. A large part of the value of fresh pasture and soiling crops and silage and roots is in their succulence. In drying they lose more than water. This might easily be supplied, but in supplying this we should not restore all of their lost value. Argument on this point in a farmers' bulletin should be superfluous. No farmer who understands feeding other roots or apples or pumpkins to his farm animals will hesitate to feed sweet potatoes because their specialty is not "dry matter." Nor will he expect them to take the place of more concentrated food stuffs. Only actual feeding tests and successful practice can fix values beyond question.

No records are found of experimental feeding tests in which sweet potatoes are compared with other roots or with other succulent provender under conditions which might make such tests valuable. We must, therefore, turn to the practice of the best farmers, and this shows nothing inconsistent with the results obtained by the analysts. All kinds of stock, including poultry, are fond of sweet potatoes, and when fed with judgment, thrive on them.

The best results from sweet potatoes are obtained when they are fed with concentrated nitrogenous food stuffs like cotton-seed meal or linseed meal. The farmer who feeds his pigs all the sweet potatoes they will eat without other food fitted to supply the deficiencies of the sweet potatoes, and expects them to grow fat on that diet, is sure to be disappointed. He has set them a task harder than making bricks without straw. In the nature of the case they can not perform it; but the fault is not with the sweet potatoes.

The Alabama Agricultural Experiment Station has published a bulletin entitled "Peanuts, Cowpeas, and Sweet Potatoes as Food for Pigs." The sweet potatoes were fed as a substitute for corn meal and in connection with ground peas. The result was not favorable to the sweet potatoes.

The author says: "This result was probably due, in part, to the fact that the pigs would not eat a sufficient quantity of the bulky ration to obtain the same amount of dry matter that was furnished by full rations of the more concentrated mixture."

This experiment is valuable in demonstrating, as fully as one experiment under the conditions noted can demonstrate, that pigs which have been brought up on a concentrated ration (corn and cowpeas) will not thrive on a ration composed of three-fourths sweet potatoes and one-fourth ground cowpeas. Or if a conclusion so broad as this is not warranted, it is at least safe to infer that one week did not suffice to adapt the taste and digestive system of the pigs to the new ration. While this experiment does not fix the value of sweet potatoes as a food for pigs, it is important in marking one of the limits to the field of inquiry. If the pigs had been accustomed from the start to a bulky ration, or if this ration had been made up of more peas and less sweet potatoes, or if cotton-seed meal or linseed meal had been substituted in part or in whole for the ground peas, the result might have been more favorable to the sweet potatoes.

So far as is known to the writer from his own experience and from the testimony of others who have fed sweet potatoes in moderate quantities with concentrated foods which supplied their deficiency in nitrogen, the results of such feeding have always shown great value in the sweet potatoes. But it is not always possible on the farm to give that close attention to experiments which is a necessary ground work of broad and trustworthy conclusions. This work belongs to the experiment stations, and some of the stations in the sweet potato growing States have already made experiments on the feeding value of both the tubers and the vines, especially with pigs. These experiments could probably be extended with profit.

Sweet-potato growing has reached its best commercial development in sections far removed from the tropics. This has been controlled by conditions of market and transportation, and these conditions are permanent so far as home markets are concerned. Nevertheless, sweet potatoes are more at home under the climatic conditions that favor cotton, and with a European demand we may expect a corresponding development of their culture in the cotton States. Low-priced lands, long growing seasons, and mild winters favor cheap production. In these States sweet potatoes have long been planted for stock feeding, and they are found profitable notwithstanding the expense and waste that attend present methods of harvesting and feeding.

If, in addition to the use of the best implements for harvesting and the adoption of economical methods of feeding, it should be found practicable to preserve the vines as hay or silage in good condition for winter use, the sweet potato will be of immense value in developing live-stock interests in the South.

Some enterprising dairymen in the South plant sweet potatoes largely for their cows. They find that the vines make an excellent green food and are preferred to green cowpea vines for that purpose. They are sometimes cured into a coarse hay which is thought to be about equal to Bermuda grass hay. These dairymen do not feed the roots as a substitute for concentrated foods, but as a supplement to these foods and to take the place of the green food of summer in stimulating a large flow of milk without loss of quality. There are few subjects of greater practical moment to the people of the South than the development of live-stock interests, and they have in the sweet potato a powerful ally waiting to help them.

SUGGESTIONS FOR EXPERIMENTS.

This bulletin would be incomplete without a few suggestions for future experiments, public and private, in sweet-potato culture.

Such experiments should be thoroughly scientific, but no less thoroughly practical. Being scientific they must, in dealing with a practical subject, lead to practical results, and being practical they can not fail to be scientific. If there be any theory of agricultural experimentation which has no place for the common sense of successful farmers, such theory has no place in a discussion which aims to be, first and last, practical. Experimenters who should exhaust themselves and the funds intrusted to them in efforts to demonstrate the axioms of agriculture would be neither practical nor scientific.

We have varieties of sweet potatoes well suited to the requirements of our markets and others for stock feeding. If these varieties are kept from deteriorating and improved by a careful selection of tubers for propagating there may be no pressing need for new varieties. We know the soils best adapted to sweet-potato culture and the climatic conditions on which success depends. We know how to propagate plants, transplant, cultivate, and harvest. The diseases of sweet potatoes and their insect enemies have the attention of specialists to whom these subjects can be left with confidence. Canning is well understood, and desiccating, and the manufacture of flour and starch are being studied by capable men. What, then, remains for investigation and experiment?

Improvement of varieties is always in order. No record is found of a systematic selection of tubers for propagating, extending through several years, for the purpose of developing varieties in the direction of their best qualities. Careful work in this line could hardly fail to

bring good results. Beyond this, if all varieties or supposed varieties for which merit is claimed should be collected and cultivated for several years under favorable conditions and with a system calculated to develop excellence, planters might, at the conclusion of such a course, be able to select from a few varieties of marked characteristics such as give promise of special usefulness to them. The value of such work in establishing varieties and determining their relative worth by comparison and in opening the way for an orderly nomenclature can not be doubted.

In fertilization there are several open questions. Growers are spending money for some fertilizer ingredients in excess of their needs and losing more through failing to supply enough of others. Particularly is this true when made-up fertilizers are used. There is no doubt that good crops of sweet potatoes may be grown on suitable soils by applying any of the standard potato fertilizers in sufficient quantity. The only objection to this is in the expense. There is great diversity in sweet-potato soils, and a planter who does not know his soil can not use it to the best advantage. Careful and continuous experimentation on the farm is essential even when general principles are well understood. The work of discovering general principles belongs to the experiment stations—application of these principles to the farmer. Some good work has been done at the stations toward ascertaining the quantities of nitrogen, potash, and phosphoric acid that may be used with profit on average soils. The results obtained have been widely diverse, but they serve in some sort as a guide. These elements are not equally available when supplied in different forms, and the work of the experiment stations has not gone far enough in determining availability, particularly of green manures. The effect of bulky material, like pine leaves, straw, and cornstalks, should also be investigated.

Preparation for planting is not so generally understood as it should be. Some successful planters plow deep, others shallow or not at all. The latter say that deep plowing makes long rather than plump tubers. The advocates of deep plowing deny that it has any such effect.

The storing of sweet potatoes so as to keep them in the best condition at a moderate cost calls for particular attention. The problem of supplying sweet potatoes in winter at points remote from the sweet-potato districts, and to which transportation in winter is expensive and risky, is really a problem in storing. The writer is not aware that any experiments have been made in packing sweet potatoes in barrels or crates at the time of harvesting, shipping immediately to remote points and storing there in rooms equipped for that purpose for use in winter and spring. If this shall be found practicable the question of supplying the cities and towns of the northern parts of the United States and of Canada in winter will be settled. And whatever may be found

practicable in storing after shipment in our Northern States and in Canada may be expected to apply in Europe.

The preservation of the vines in the form of silage for stock feeding is worthy of the best attention of experimenters.

PRODUCTION OF SWEET POTATOES.

Speculations concerning the origin and early history of the sweet potato are not of sufficient practical value to call for an extended reference to them in a bulletin of this kind.

It is probable that sweet potatoes were cultivated and sold or bartered long before the earliest historian wrote.

The census reports of sweet potatoes produced in the United States are as follows:

	Bushels.		Bushels.
1850	38,268,148	1880	33,378,693
1860	42,095,026	1890	43,950,261
1870	21,709,824		

The report of 1890 gives the production of the several States and Territories as follows:

	Bushels.		Bushels.
Maine	267	Missouri	561,551
New Hampshire	93	North Dakota	40
Vermont		South Dakota	140
Massachusetts	137	Nebraska	43,343
Rhode Island		Kansas	533,846
Connecticut	548	Kentucky	904,125
New York	2,281	Tennessee	1,973,625
New Jersey	2,254,344	Alabama	4,339,170
Pennsylvania	89,936	Mississippi	3,207,125
Delaware	202,914	Louisiana	1,912,080
Maryland	408,549	Texas	5,505,452
District of Columbia	31,256	Arkansas	1,822,960
Virginia	2,816,041	Montana	
North Carolina	5,665,391	Wyoming	5
South Carolina	3,063,040	Colorado	5,847
Georgia	5,616,317	New Mexico	5,351
Florida	1,749,679	Arizona	8,619
Ohio	148,408	Utah	230
Indiana	177,293	Nevada	100
Illinois	451,125	Idaho	222
Michigan	9,579	Washington	2,535
Wisconsin	2,669	Oregon	508
Minnesota	365	California	120,852
Iowa	189,874		

FARMERS' BULLETINS.

The following is a list of the Farmers' Bulletins available for distribution, showing the number, title, and size in pages of each. Copies will be sent to any address on application to Senators, Representatives, and Delegates in Congress, or to the Secretary of Agriculture, Washington, D. C.:

16. Leguminous Plants. Pp. 24.
19. Important Insecticides. Pp. 32.
21. Barnyard Manure. Pp. 32.
22. The Feeding of Farm Animals. Pp. 32.
23. Foods: Nutritive Value and Cost. Pp. 32.
24. Hog Cholera and Swine Plague. Pp. 16.
25. Peanuts: Culture and Uses. Pp. 24.
26. Sweet Potatoes: Culture and Uses. Pp. 30.
27. Flax for Seed and Fiber. Pp. 16.
28. Weeds: And How to Kill Them. Pp. 32.
29. Souring and Other Changes in Milk. Pp. 23.
30. Grape Diseases on the Pacific Coast. Pp. 15.
31. Alfalfa, or Lucern. Pp. 24.
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51. Standard Varieties of Chickens. Pp. 48.
52. The Sugar Beet. Pp. 48.
53. How to Grow Mushrooms. Pp. 20.
54. Some Common Birds. Pp. 40.
55. The Dairy Herd. Pp. 24.
56. Experiment Station Work—I. Pp. 31.
57. Butter Making on the Farm. Pp. 16.
58. The Soy Bean as a Forage Crop. Pp. 24.
59. Bee Keeping. Pp. 32.
60. Methods of Curing Tobacco. Pp. 16.
61. Asparagus Culture. Pp. 40.
62. Marketing Farm Produce. Pp. 28.
63. Care of Milk on the Farm. Pp. 40.
64. Ducks and Geese. Pp. 48.
65. Experiment Station Work—II. Pp. 32.
66. Meadows and Pastures. Pp. 28.
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68. The Black Rot of the Cabbage. Pp. 22.
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70. Insect Enemies of the Grape. Pp. 23.
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